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ORIGINAL ARTICLE

Acute Myocardial Infarction During Pregnancy and the Puerperium in the United States

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Abstract

Objective: To analyze trends in the incidence, in-hospital management, and outcomes of acute myocardial infarction (AMI) complicating pregnancy and the puerperium in the United States.

Patients and Methods: Women 18 years or older hospitalized during pregnancy and the puerperium were identified from the National Inpatient Sample database from January 1, 2002, to December 31, 2014. *International Classification of Diseases, Ninth Revision* diagnosis and procedure codes were used to identify AMI during pregnancy-related admissions.

Results: Overall, 55,402,290 pregnancy-related hospitalizations were identified. A total of 4471 cases of AMI (8.1 [95% CI, 7.5-8.6] cases per 100,000 hospitalizations) occurred, with 922 AMI cases (20.6%) identified in the antepartum period, 1061 (23.7%) during labor and delivery, and 2390 (53.5%) in the postpartum period. ST-segment elevation myocardial infarction occurred in 1895 cases (42.4%), and non-ST-segment elevation myocardial infarction occurred in 2576 cases (57.6%). Among patients with pregnancy-related AMI, 2373 (53.1%) underwent invasive management and 1120 (25.1%) underwent coronary revascularization. In-hospital mortality was significantly higher in patients with AMI than in those without AMI during pregnancy (adjusted odds ratio, 39.9; 95% CI, 23.3-68.4; $P<.001$). The rate of AMI during pregnancy and the puerperium increased over time (adjusted odds ratio, 1.25 [for 2014 vs 2002]; 95% CI, 1.02-1.52).

Conclusion: In patients hospitalized during pregnancy and the puerperium, AMI occurred in 1 of every 12,400 hospitalizations and rates of AMI increased over time. Maternal mortality rates were high. Additional research on the prevention and optimal management of AMI during pregnancy is necessary.

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Acute myocardial infarction (AMI) during pregnancy is an uncommon but potentially devastating complication of the gravid state. Acute myocardial infarction occurs during pregnancy with an incidence of approximately 3 to 10 cases per 100,000 deliveries[1-4] and is associated with 5% to 7% maternal case-fatality rate with grave risks to the developing fetus.[2,3] Hormonal and hemodynamic changes in the cardiovascular system and the hypercoagulable state of pregnancy in part account for the increased risk of AMI during pregnancy, which occurs with a frequency approximately 3- to 4-fold higher than that for nonpregnant women of childbearing age.[5] In addition, previous population-based studies reported that maternal age, tobacco use, hypertension, diabetes mellitus, and thrombophilia are independent risk factors associated with AMI during pregnancy.[2,3] Investigation of AMI during pregnancy or the puerperium has been particularly challenging because of low incidence of events and heterogeneous clinical presentations. Consequently, recent epidemiology and data on the contemporary approaches to the management of AMI during pregnancy are limited. We analyzed hospital admissions from a large national database to evaluate trends in the incidence, in-hospital management, and outcomes of AMI complicating pregnancy and the puerperium in the United States.

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PATIENTS AND METHODS

Data were obtained from the Agency for Healthcare Research and Quality's Healthcare Cost

and Utilization Project National Inpatient Sample (NIS) database from January 1, 2002, to December 31, 2014. The NIS is the largest publicly available all-payer database and contains discharge-level administrative data on inpatient diagnoses and procedures from a 20% stratified sample of US hospitals until 2012 and a 20% stratified sample of discharges from all US hospitals thereafter. Sampling weights were applied to discharge records to generate national estimates for the United States.[6]

Women 18 years or older who were hospitalized during pregnancy and the puerperium were identified using *International Classification of Diseases, Ninth Revision* (*ICD-9*) diagnosis and procedure codes for labor and delivery as well as *ICD-9* diagnosis codes for antepartum and postpartum conditions. The *ICD-9* codes used to identify pregnancy-related admissions are detailed in Supplemental Table 1 (available online at http://www.mayoclinicproceedings.org). Acute myocardial infarction was identified using *ICD-9* diagnosis codes for non—ST-segment elevation myocardial infarction (NSTEMI) (410.71) and ST-segment elevation myocardial infarction (STEMI) (410.01-410.61, 410.81, and 410.91) in any position. In patients with AMI, coronary artery dissection was identified using the *ICD-9* diagnosis code 414.12 and stress (takotsubo) cardiomyopathy was identified using the *ICD-9* diagnosis code 429.83.

In-Hospital Management and Outcomes

Invasive management of AMI was identified using *ICD-9* and Clinical Classifications Software procedure codes for invasive coronary angiography, percutaneous coronary intervention (PCI), or coronary artery bypass grafting (CABG) during inpatient hospitalization. In patients who underwent PCI, procedure codes for bare-metal stent (*ICD-9* procedure code 36.06) and drug-eluting stent (*ICD-9* procedure code 36.07) placement were identified. The procedure code for intravascular ultrasound use was also identified (*ICD-9* procedure code 00.24). Patients who did not have these invasive procedures coded were considered to have been managed conservatively. The primary outcome was in-hospital all-cause mortality.

Statistical Methodology

Categorical variables were reported as count (percentage) and compared using Rao Scott chi-square tests. Continuous variables were reported as mean ± SE. Comparisons were made using the SAS Software (SAS Institute, Inc.) PROC SURVEYREG procedure for continuous variables and the PROC SURVEYFREQ procedure for categorical variables to incorporate the complex survey design. Testing of trends over time was conducted using the Cochran-Armitage test. Multivariable logistic regression models including patient demographic characteristics, cardiovascular risk factors, and comorbidities as covariates were used to estimate the adjusted odds of AMI. Models included age, race/ethnicity, obesity, obstructive sleep apnea, tobacco use, alcohol abuse, drug abuse, hypertension, dyslipidemia, diabetes mellitus, previous coronary revascularization (with either PCI or CABG), known heart failure, history of atrial fibrillation, rheumatoid arthritis, systemic lupus erythematosus, anemia, and the diagnosis of a malignant neoplasm as covariates for adjustment. Multivariable logistic regression models used to estimate the adjusted odds of invasive management in patients with myocardial infarction also included the diagnosis of STEMI, cardiogenic shock, and hospital characteristics as covariates. Sampling weights were applied to determine national incidence estimates in all analyses according to Healthcare Cost and Utilization Project guidelines guidance.[6] Statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc.). Two-sided *P* values less than .05 were considered to be statistically significant. The NIS is a publicly available, deidentified data set, and the study was exempt from review by the institutional review board.

Patient Involvement

Patients were not involved in developing the research question, study outcome measures, study design, or conduct of the study. No patients provided input into the data analysis or interpretation of the results. There are no plans to disseminate the results of the research to study participants. No patients served as authors or contributors to this work.

RESULTS

Overall, 55,402,290 hospitalizations during pregnancy and the puerperium were identified among women 18 years or older in the United States (an average of 4,261,715 hospitalizations